

EXPERIMENTAL RESEARCH ON THE IMPLANTATION OF THE URETERS INTO THE RECTUM.¹

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PREFACE.

IT has been the object of the author of this paper to demonstrate, by experimental research, the possibility of relieving many of the grave disorders of the bladder, in which the urine constitutes a permanent source of the irritation, by deviating the course of the urine from the bladder into the rectum; also to avoid the necessity of performing a nephrectomy in laparotomies for neoplasms, in which one or both of the ureters may be involved, by implanting the ureter into the rectum.

The numerous pathological conditions to which the bladder is heir, that sooner or later must terminate fatally, unless some relief, other than that known and practiced at the present time, is afforded, is sufficient ground for warranting the following experiments in search of some surgical procedure that would furnish permanent relief to those suffering from these distressing maladies, by the physiological exclusion of the bladder by operative interference.

COMPARATIVE ANATOMY.

It will be observed by examining the specimen from the chicken (see plate No. 1) which consists in a section of a male chicken, including the lungs, the testicles with the vas deferens,

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the kidneys with their ureters, and the cloaca with a portion of the rectum and the two cæca: that the ureters empty into the cloaca, which is simply a continuation of the rectum; and that what we propose to produce by artificial means in the dog is a natural condition in the chicken, and in fact in all fowls excepting the ostrich, which is the only bird honored with a bladder.

You will observe by examining this specimen that the ureters and vasa deferentia are bound together by a fold of the peritoneum, which I have removed on the one side, separating the two conduits, in order that they may be more easily traced from their origin in the testicles and kidneys, to their termination in the cloaca.

In the dog the location of the kidneys and the ureters compare very closely with that of man, and the same may be said of the bladder, although the pelvic cavity in the dog is not proportionately quite as deep as that of man. The relation of the ureters in the dog, with that of the large arteries, veins, nerves, intestines and vas deferens are practically the same as that of man, with the possible exception that the ureters lie more loosely imbedded in the peritoneal fold, than in man. The vas deferens in the dog, however, passes further back over the fundus of the bladder, and then takes more of a parallel course with the ureter than in man. They both pass along the sides of the bladder side by side, the ureter passing over the spermatic cord into the bladder at its lower third, while the cord continues on down along the neck of the bladder, and enters the prostatic portion of the urethra at its upper side. During their passage along the lower half of the bladder, they are held firmly to the latter by the peritoneum. Before that they both lie in loose folds of the peritoneum and continue their parallel course for some distance (varying in different dogs), and then separate, the one passing back to the testicles and the other up to the kidneys.

PATHOLOGICAL ANALOGY IN MAN.

In recto-vesical fistula, occurring in man, we have in a crude manner, a condition produced by disease, analogous to the natural condition found in the fowl, whereby the urine finds its way into the rectum through a fistulous opening, and is passed with the stools.

In this condition the rectum usually becomes reconciled to the presence of the urine, and were it not for the escape of the faeces into the bladder and producing acute cystitis, there would be little to fear from this malady, excepting some possible inconvenience.

PRELIMINARY CONCLUSIONS.

With this condition occurring as a natural mode of existence in the fowl, and a pathological predicament found occasionally in man, in which the rectum becomes reconciled to these abnormal circumstances, we are led to the conclusion that with proper surgical care, the urine can be turned into the rectum, and the bowel be made to accommodate itself to its continued presence. We may thereby be enabled to relieve grave pathological conditions arising in the bladder, (that are aggravated by the presence of the urine in that receptacle,) as well as injuries to the ureter in laparotomies, which would otherwise require a nephrectomy, and thus prolong life and give a degree of comfort to a class of patients who without relief, have little to look forward to in this world excepting continued suffering and final dissolution.

Encouraged by these preliminary considerations, we determined to conduct a series of experiments on dogs, with a view of settling so far as we could, the feasibility of such a surgical procedure, together with some of the difficulties that attend such an operation.

EXPERIMENTS.

Our experiments have been confined to an attempt at unilateral and bilateral implantation of the ureters into the rectum, and the special methods by which it was accomplished or attempted, will be detailed in the following cases.

EXPLANATION.

The first eight experiments were made between the hours of 10 o'clock P. M. and 2 o'clock A. M., with the aid of a lamp, which did not afford sufficient light for properly conducting a class of experiments of this character; and hence the mistakes which as a natural consequence followed. But whilst the mistakes were perplexing, yet they are not without some value, and have fur-

nished suggestions for further experimental investigations at some future time.

After the eighth experiment, arrangements were made to conduct our work in daytime, in a well lighted room; even at the expense of severe criticism by a puny paper, and a few anti-vivisectionists, who think more of worthless curs than they do of their fellow man.

EXPERIMENTS.

Experiment No. 1 was only for the purpose of studying the anatomy of the abdominal viscera of the dog with special reference to the relations of the kidney, the rectum, the bladder, the Fallopian tubes and the ureters, with each other, in a living dog.

UNILATERAL IMPLANTATIONS.

Experiment No. 2 was made on a large healthy young dog of thirty-five pounds, and the right ureter ligated about half an inch from the bladder, and subsequently divided above the ligature, and the ureter with a portion of its surrounding peritoneum dissected out for a distance of about two inches.

The rectum was then opened in a line with its long axis about six inches above the anus and the ureter inserted through this opening, and held there by a pair of forceps, and the slit in the bowel closed with six continued sutures, which included the fold of the peritoneum, which was removed with the ureter, thus fixing the latter firmly in the opening of the bowel without transfixing it or obstructing its lumen, and at the same time holding the peritoneal surface of the rectum and ureter in close contact, in order to assist in securing rapid adhesions.

After thoroughly cleansing the abdominal cavity the external wound was closed with a continuous silk suture, and the wound dressed antiseptically. For two days after the operation his dogship was a little feverish and drank both water and milk, but ate little. After the second day, however, he improved rapidly; the abdominal wound healed by first intention, and his appetite became good, eating anything of the food kind he was given.

The bowels did not move for three days after the operation, when he had several watery stools. From that on his bowels moved regularly, from three to five times a day; usually two or three of the stools were of a very watery character, whilst the rest of the stools were semi-solid. At no time did they contain any blood. On the

sixth day after the operation he was removed from the warm room to the barn, and on the eighth day all the dressings were removed. He was kept confined until the fourteenth day when he was given his liberty. He recovered fully, but some eight or ten weeks after the operation an officious student killed him and removed the specimen during my absence; unfortunately this unwarranted procedure lost me the specimen, as it was rendered useless by wanton mutilation.

Experiment No. 4 was on a small young bitch of the lap dog persuasion, of about eight pounds in weight and rather delicate. The right ureter was ligated about an inch from the bladder with a silk ligature, after which it was divided and the renal end held with a pair of forceps, while it was loosened from its peritoneal mooring for about two inches, being careful not to strip off the peritoneal cover that partially surrounded it.

The rectum was opened about six inches above the anus on its lower aspect, in a line with its long axis, which opening was about half an inch in length. After controlling the hemorrhage the ureter was inserted into the rectum, and fastened there by a continuous silk suture, which included its peritoneal covering, and by the inversion of the edges of the rectal wound, I was enabled to bring the serous membranes of the two edges of the bowel in close contact with the serous covering of the ureter, thus facilitating rapid adhesions; the remainder of the rectal wound was then carefully closed with a continuous suture.

The abdominal cavity was thoroughly cleansed, and the intestines carefully replaced, and the external opening closed with a continuous silk suture, and the usual bandages applied, and the dog placed in a warm room. She soon recovered from the operation, and drank freely of milk and water; after the third day she was given solid food; the bowels moved freely on the same day, but we could not discover any blood in the stools; from that on they moved two or three times daily, the stools being watery, mixed with solid and semi-solid feces.

The animal continued to improve steadily, and by the twelfth day ate and drank as usual, but continued to have about the same number of stools, and of the same general appearance as those already described. On the 24th day after the operation she was to all appearances just as well as ever, when she was asphyxiated with carbon dioxide, and the result of the operation carefully examined. The post-mortem revealed some adhesions of the intestines to the parietal peritoneum along the line of the external incision, also adhesions of the uterus to the under side of the rectum, and adhesions to the Fallopian tubes on each side of the wound in the rectum, which

intruded very much on the right ureter, (which, of necessity, lay over the right Fallopian tube), and as a consequence obstructed the lumen of this ureter. With the exceptions of a few adhesions around the cystic end of the ureter, which were continued over the fundus of the bladder, there was nothing worthy of further mention pertaining to the viscera.

By examining specimen No. 4 (see plate No. 4a) you will observe that it consists in a section of the rectum, both kidneys and ureters, the uterus and both Fallopian tubes, together with the bladder. The right kidney is congested and shows evidence of acute nephritis, which I think was caused by the adhesions of the right Fallopian tube to the rectum and right ureter, the adhesion of which had partly obstructed the ureter, and thus produced hydronephrosis with some acute nephritis from the damming up of the urine. It is interesting to notice how perfectly the right ureter is welded, as it were, into the rectum, almost as perfectly as if it had grown there naturally whilst nature has used one of the crescentic folds of the mucous membrane of the bowel to act as a valvular protection at the opening of the ureter, which has been implanted into its walls. (See plate No. 4b).

It will be observed that notwithstanding the constant flow of urine into the rectum, there was not the least evidence of irritation of its mucous membrane. The bladder had become very much contracted, whilst the left kidney and its ureter, the Fallopian tubes, and ovaries, remain perfectly normal.

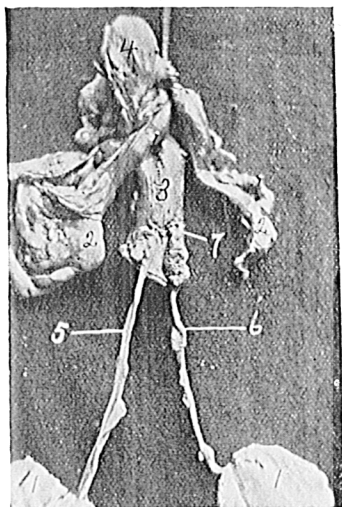
Experiment No. 9 was made on a bull pup of about fifteen pounds weight. The ordinary abdominal incision was made, and the left ureter was implanted into the rectum. In this case the incision in the rectum was only large enough to admit the ureter, without constricting it. The rectal wound was closed with two aseptic silk sutures; the lower suture was taken after the manner of the Lembert stitch, which also included the flaps of the peritoneum on either side of the ureter, being careful at the same time not to include the ureter and to carefully invert the edges of the wound in the rectum, thus closing the rectal wound and fixing the ureter in the same, as well as bringing the serous surfaces in close contact with each other. The upper suture was taken in the same manner, with the exception that it was passed *under* the ureter instead of over it, as in the lower suture; thus leaving the lumen of the ureter free from mechanical stenosis. Aseptic silk was used to ligate the cystic end of the ureter, which soon becomes encysted. The external wound was closed in the ordinary manner, and his pupship placed in a warm room, which was evenly heated by a

furnace. He soon rallied from the operation and the following day his bowels moved; the feces being mixed with urine, which was easily detected by their peculiar odor. He drank freely of milk and did not seem to be particularly disabled. On the third day after the operation he ate some, and drank freely of milk, and from that on, no particular attention was given in reference to his nourishment, except that he was furnished with plenty. On the fourth day we removed the dressing and found the external wound practically healed by first intention; and on the sixth day he was removed to the barn and given common ordinary accommodations, with coarse food mixed with bones, of which he ate freely and experienced no inconvenience. His bowels moved regularly two or three times a day, the stools being mixed with urine, and at the same time he would occasionally pass urine from the bladder. Having fully recovered he was asphyxiated on the 25th day after the operation, and the result of our experiment investigated. The external wound had healed with but few adhesions to the bowels and omentum.

By examining specimen No. 9 (see plate No. 9a), you will observe the bladder is very much atrophied; and by a close examination of the specimen, the encysted ligature used in tying the cystic end of the ureter can easily be seen. On further examination you will find the left kidney normal, as well as its fellow, whilst the ureter of the left kidney will be found completely attached to the rectum, just as perfectly as if it was in its normal position, and nature had placed it there. Not the least renal congestion existed, and not a particle of hydronephrosis, showing that the lumen of the ureter was not in the least obstructed. There was no difficulty in passing a ligature from the pelvis of the left kidney through the ureter and out of the opening in the mucous membrane of the rectum, (see plate No. 9-b), or by pouring water into the pelvis of the kidney, it will find a ready escape through the ureter into the rectum. You will also observe that nature has done its work in uniting the mucous membrane of the rectum, with that of the ureter, perfectly, whilst the artificial opening in the rectum is carefully guarded by a fold of the rectal mucous membrane. In fact the specimen is almost a unique one, and clearly demonstrates the practical possibility of implanting the ureter into the rectum, thus diverting the urine from its natural receptacle to the rectum, without serious injury.

BILATERAL IMPLANTATIONS.

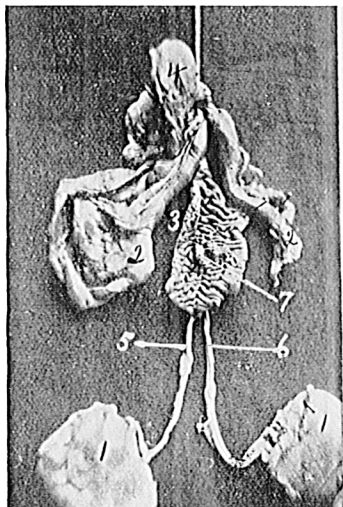
Experiment No. 3 was made on a small, delicate bitch of ten pounds weight, which had had pups about eight weeks previous to the



SPECIMEN No. 3a.

Bilateral implantation of the ureters into the rectum. Dog died of acute peritonitis on the 4th day. (A.)

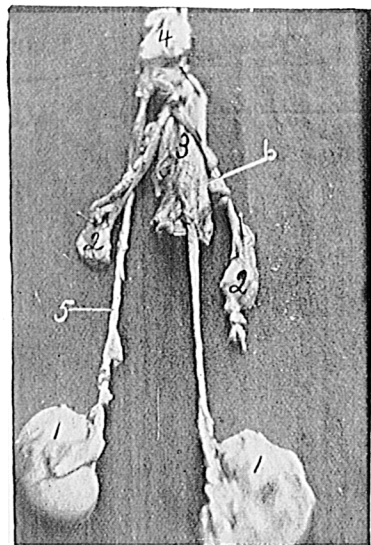
1-1. Kidneys. 2-2. Ovaries and Fallopian tubes. 3. Rectum. 4. Bladder. 5 and 6. Left and right ureters. 7. Point of implantation of ureters into rectum.



SPECIMEN No. 3b.

Bilateral implantation of the ureters into the rectum. Dog died of acute peritonitis on the 4th day. (B.)

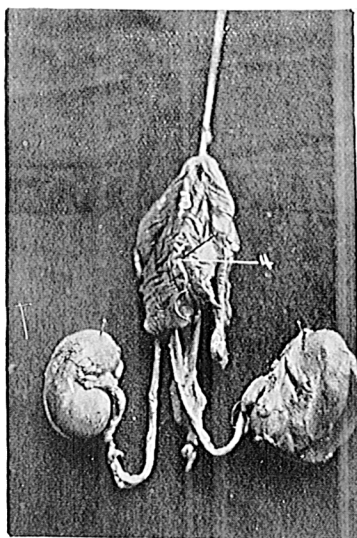
1-1. Kidneys. 2-2. Ovaries and Fallopian tubes. 3. Mucous membrane of rectum. 4. Bladder. 5 and 6. Right and left ureters. 7. Ends of ureters protruding into rectum.



SPECIMEN No. 4a.

Implantation of the right ureter into rectum. Dog killed on the 24th day after the operation. (A.)

1-1. Kidneys. 2-2. Ovaries and Fallopian tubes. 3. Rectum. 4. Atrophied bladder. 5. Left ureter. 6. Point of implantation of right ureter into rectum.



SPECIMEN No. 4b.

Implantation of the right ureter into the rectum. Dog killed on 24th day after operation.

1-1. Kidneys. 2. Fallopian tube and ovary. 3. Mucous membrane of rectum. 4. Opening where right ureter enters rectum.

operation, and consisted in the implantation of both ureters into the rectum. Owing to her recent puerperal state she was very vascular, causing us more than the usual amount of trouble from hemorrhage during the operation.

When the abdominal cavity was opened a wonderfully distended bladder was found, that reached more than two-thirds of the way to the transverse colon, which we were obliged to empty before proceeding with the operation. After considerable difficulty the bladder was finally emptied, when we proceeded with the next step of the experiment which consisted in ligating both ureters about half an inch from the bladder. Having had a great deal of trouble in inserting the ureter into the rectum and holding it there without injury, and at the same time to prevent the escape of the urine into the peritoneal cavity, we decided to devise some other plan than the one *previously* employed. With the aid of a few suggestions from my friend Dr. J. W. Craig, we devised the following method, which consists in throwing a loop around each ureter, consisting of a double-braided silk ligature, with the ends tied together and armed with a slightly curved needle, this served two purposes—first, to prevent the possible escape of urine into the peritoneal cavity; and second, to assist in inserting the ureters into the artificial opening in the rectum. Having the ureters both ligated at the cystic end and firmly held with a silk noose, as it were, at the renal end, we divided each of them between the ligature and the noose, after which the renal end was carefully dissected loose from the lumbar peritoneum, being careful to leave the ureter covered with a flap of peritoneum for its protection and nutrition.

These loops were intrusted to an assistant, who kept them on a gentle stretch until a slit about an inch in length was made in the rectum, which in this case was opened about six inches above the anus on its lower aspect (when the dog is standing), in a line with the long axis of the bowel, and a grooved director inserted about an inch into this opening from above downward. The needle attached to one of the loops surrounding the ureter was then taken and inserted along the grooved director and carried out about an inch below the inferior commissure of the opening in the rectum. By gently pulling on this ligature the ureter was easily carried into this slit in the rectum; the same procedure was had on the other ureter, which in this case was inserted in the same incision with its fellow. It was our aim to have from half to three-quarters of an inch of each ureter inserted into the rectum: we then closed the rectal wound with a continued silk suture, which embraced the flaps of the peritoneum surrounding the

ureters, thus firmly fixing them in the rectum, at the same time without obstructing the lumen of either ureter.

The loops were then put on the stretch and cut off close to the peritoneal coat of the bowel, the elasticity of which allowed the loops to drop into the lumen of the rectum, whilst the peristaltic action, together with the passage of the faeces would sweep them off of the ends of the ureters and carry them out with the stools. The abdominal cavity was then thoroughly cleansed with a warm solution of mercuric chloride, the intestines carefully replaced, and the abdominal wound closed with a double row of continuous silk sutures, with which I first closed the peritoneum and muscular walls, and afterwards the integument. I then applied a compress with a bandage, over which was placed a dressing made out of coffee sack, when she was placed in a warm room to revive. She soon rallied and drank water and milk, and had several watery stools mixed with solid faeces, but died on the fourth day.

A post-mortem was made, which showed that she died from acute peritonitis confined chiefly to the right side, the bladder being the centre of the inflammation, which extended upward along the right Fallopian tube. I am satisfied that the rough usage of the bladder, due to its extreme distension and the effort in emptying it, during the operation was the prime factor in producing the peritonitis, which, however, did not reach the point of the insertion of the ureters in the rectum.

By examining specimen No. 3 (see plate No. 3a), which consists of the bladder, a portion of the rectum, vagina, uterus, Fallopian tubes, ovaries, both kidneys and their ureters (unfortunately the one ureter was torn off by rough usage after the specimen had been placed in alcohol), you will observe (see plate No. 3b) that both ends of the ureters can easily be seen extending through the walls of the rectum into the lumen of the bowel; and, notwithstanding the very short time after the operation, they were quite firmly fixed in the walls of the rectum by adhesion of their serous surfaces. The bladder shows incipient atrophy, whilst the kidneys are apparently normal in every respect and the rectum shows no evidence of inflammation or irritation.

Experiment No. 5 (see plate No. 5) was made on a small old dog of the "lap-dog" species, which was undergoing fatty degeneration, and which had a floating kidney on the left side. In this case we inserted the left ureter about five inches above the anus, and the right ureter about seven and a half inches above the anus, in two separate

openings, each of which was closed by a continuous suture in the same manner as described in No. 3.

This dog never seemed to rally from the operation, but was drowsy and stupid, ate nothing, drank but little, and died on the third day. The autopsy revealed enlargement of the left kidney, which you will observe was commencing to undergo suppurative inflammation. The ureter on the right side, you will notice, extends fully one-fourth of an inch into the lumen of the rectum, the end of which is sloughing off, whilst the adhesions of the serous membranes of the ureter to those of the serous surface of the bowel shows a marked degree of repair for the short time elapsed after the operation, and the unfavorable condition of the dog to start with. Unfortunately the right ureter was so occluded at the uretero-rectal juncture as to very materially obstruct the flow of urine which caused some hydronephrosis, which threatened the destruction of its cortical substance. The rectum at the point of insertion of the left ureter shows the results of peritoneal inflammation, which has retarded the repair of the rectal wound in this instance more than in that of its fellow. You will observe this ureter protrudes through into the rectum about three-fourths of an inch, and whilst it shows the evidences of sloughing, there was no obstruction of its lumen, and the kidney is apparently perfectly healthy. The bladder is exceedingly small and contracted from non-use, but otherwise normal. You will perceive that I made the openings into the rectum more to the vertebral side of the bowel than in either of the former specimens, although I do not consider it of any advantage, as the hemorrhage from the hemorrhoidal vessels is more profuse the nearer you approach the vertebral aspect of the rectum.

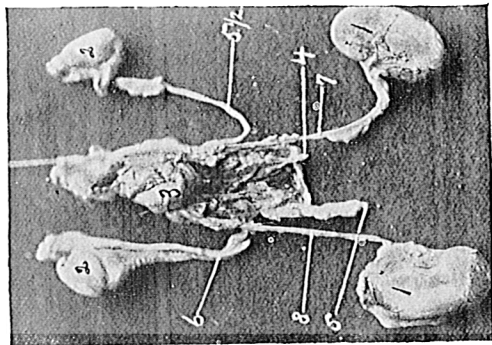
In this case death was undoubtedly the result of acute general peritonitis, which together with the fatty degeneration of the dog, prevented the reparative process of the wounds that under more favorable circumstances would have been further advanced.

Experiment No. 6 was made on a young dog of about twenty-five pounds in weight, with all the indications of being in vigorous health. The operation consisted in the *supposed* implanting of both ureters into the rectum about five inches above the anus. In this case we were annoyed considerably by hemorrhage from the hemorrhoidal vessels and also from the peristaltic action of the bowels forcing out the feces. Both ureters were supposed to have been implanted into the rectum, as previously described. The abdominal cavity was thoroughly cleansed with a bi-chloride solution, and the intestines carefully replaced, and the external opening closed by a double row of continuous silk sutures. The dog soon rallied and

took milk and water in small quantities, and by the third day seemed to feel quite comfortable. On the third day he had a motion of the bowels, which was of a watery character with semi-solid feces. From that time on his bowels moved several times each day, the stools being free and semi-solid. By the fifth day he commenced to eat solid food with a relish. On the 13th, we removed all the dressings, and found the external wound healed. He was then taken from the warm room and placed in the barn, where he was kept until the twenty-fourth day, at which time he had every appearance of being perfectly well; when he was asphyxiated by carbon dioxide, and an examination of the results of the operation carefully conducted; which revealed the fact (see specimen No. 6, plate No. 6), that we had mistaken the spermatic cords for the ureters, and had implanted both of the vasa deferentia into the rectum, whilst the ureters escaped entirely. This may appear like an inexcusable mistake, yet when we review the anatomy of the vasa deferentia and their relation with that of the ureters it will be observed that their similarity in size and outward appearance, as well as the sensation they give to the touch, together with the parallel course they take along the side of the bladder, in such close proximity to each other, being bound side by side to the lateral aspect of the bladder by peritoneal coverings, will in part at least aid you in appreciating some of the difficulties attending the operation, and the possibilities of mistaking the one for the other; until repeated operations enables the operator to become so familiar with every part of the pelvic anatomy as to positively diagnose between the ureters, vas deferens, and folds of the peritoneum, by the touch, which was my only method (owing to the use of a lamp which did not furnish me sufficient light to see them), which I have found is not so easily done as might be supposed.

Specimen No. 6, however, is not without interest, and shows the results of the operation, which, although a failure as to its original intents and purposes, proves the feasibility of successfully implanting both vasa deferentia into the rectum, and thus render the male harmless, in regard to his reproductive powers, without destroying his capacity for participating in copulation as usual, as was accidentally demonstrated in this particular instance.

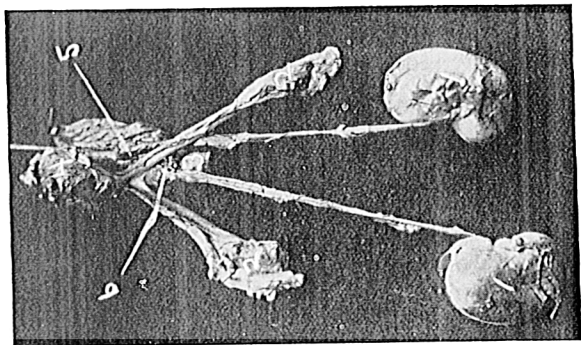
Experiment No. 7 was on a large Newfoundland bitch of forty-five or fifty pounds in weight. A six-inch opening was made in the abdominal cavity, and the ureters searched for, but owing to the profuse hemorrhage it was very difficult to find them. Numerous small vessels had to be ligated, which ordinarily would have given us no



SPECIMEN No. 8.

Implantation of folds of the peritoneum. Dog killed on the 12th day.

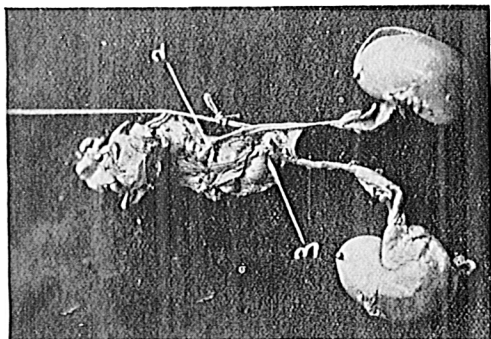
1. Kidneys, 2-3. Testicles, 3. Bladder, 4 and 5. Recurrent folds of the peritoneum implanted into the rectum, 5 1/2 and 6. Vas deferens, 7 and 8. Ureters.



SPECIMEN No. 10.

Implantation of both ureters in the rectum. Dog died 36 hours after operation of acute peritonitis.

1-2. Kidneys, 3. Ovaries and Fallopian tubes, 4. Rectum, 5. Bladder, 6. Left ureter, 7. Right ureter.



SPECIMEN No. 11.

Implantation of both ureters. Dog died 72 hours after operation of acute nephritis.

1-2. Kidneys, 3. Right ureter, 4. Left ureter, 5. Rectum, 6. Bladder.

trouble, but which in this case bled freely, and especially was it the case with the hemorrhoidal vessels, several of which we were compelled to ligate. What we supposed to be the ureters, were implanted into the rectum in the same manner as already described.

The abdominal cavity was thoroughly cleansed, and the intestines replaced, and the external wound closed with a continuous silk suture. The usual antiseptic dressings were applied, and the dog placed in a warm room to recover. She rallied from the operation without any trouble and seemed to feel quite well the next morning, when she drank both milk and water, and with the exception of vomiting occasionally, she showed but little inconvenience from the operation. The bowels moved the second day after, when her appetite returned and her recovery seemed to progress without any apparent interruption. The bowels moved from two to four times a day, the stools being of a watery character at times, and at others quite solid, mixed with some liquid. On the eighth day she was taken from the warm room to the barn; but on the eleventh day she was taken with symptoms of peritonitis and began passing watery stools mixed with blood, and died on the thirteenth day.

A post-mortem examination revealed the fact that she died of acute peritonitis. There were no adhesions to speak of, but some serous effusion into the peritoneal cavity, and general congestion of the entire abdominal viscera. In this case we were again misled, but not as in the former case, by the vas deferens, but by a fold of the peritoneum, which we had implanted into the rectum instead of the ureters.

By examining specimen No. 7 (see plate No. 7), you will observe that we succeeded in ligating the right ureter close to the bladder, but were misled by a fold of peritoneum, which was dissected loose and implanted instead of the ureter. On the left side we were not even so fortunate as to get the ureter ligated, but missed it entirely; being again misled by a fold of the peritoneum. This case, like the former, proved that it was an ill wind that did not blow some good.

The important part of this operation was the fact that one ureter was ligated for nearly two weeks and yet did not set up destructive inflammation of the kidney, whose ureter was distended with urine to the size of your little finger, whilst the pelvis of the kidney was distended to the size of a small hen's egg; notwithstanding the hydronephrosis, there was not to exceed an ounce and a half to two ounces of urine in both; evidently being the whole amount of urine secreted by that kidney, during nearly a fortnight, which shows almost a complete suspension of the functions of the kidney for that period (or,

possibly, reabsorption of the urine), without even inflammation or destruction of its cortical substance. You will observe the rectal wound has healed, whilst the implanted peritoneal fold has sloughed off on the mucous side of the rectum; and with the exception of a few frail adhesions, over the wound of the rectum, the abdominal viscera were just as if nothing had ever happened.

In this case, as in No. 6, we were again surprised at our mistake, which impressed us more than ever with the difficulty of learning to distinguish, by the touch, different organs of the abdominal cavity, and the necessity of being enabled to more satisfactorily apply the sense of vision in these experiments; and yet our mistake is not without value; and hence we have recorded it in this report.

Experiment No. 8 was on a young shepherd dog of twenty pounds weight, on which we presumed to have implanted both ureters about five inches above the anus. During the operation we had to ligate several branches of the pudic and hemorrhoidal arteries. Owing to a distended bladder, the operation was proportionately complicated, and rendered more difficult.

In this case the same methods were followed as in the cases already described. The dog soon rallied from the operation, and the next morning drank milk quite freely. On the third day the bowels moved very freely, and from that time on he seemed to improve, eating and drinking regularly. His bowels continued to move two or three times a day, and were of a semi-solid character mixed with liquid. On the twelfth day he was asphyxiated with carbon dioxide, and the results of our efforts examined. With the exception of a few adhesions, the abdominal viscera presented a normal appearance. Again, to our surprise and chagrin, we found that we had failed to secure the ureters, but had implanted a fold of the peritoneum on each side, instead of the ureters, which we found unmolested.

By examining specimen No. 8 (see plate No. 8) which consists of both kidneys and their ureters, both testicles with their vasa deferentia, a section of the rectum, with the bladder and prostate, you will observe that the rectal wound has been completely repaired, the ends of the implanted peritoneal folds having both sloughed off on the inside of the bowel, the mucous surface of which had healed completely. On the one side of the rectum you will notice a portion of the peritoneal fold which was implanted and which I have purposely left. Unfortunately, the one on the opposite side was so adherent to a loop of the ilium as to render it impossible to separate and preserve it.

This specimen shows very clearly the close relations maintained between the ureters and vas deferens, both before and after reaching

the bladder; you will notice that after running a parallel course for nearly two inches, the ureter passes (when the dog is standing) under the vas deferens, and enters the bladder at its lower third, whilst the vas deferens continues down along the side of the bladder, and finally, after passing over its neck, enters the urethra at the beginning of the prostatic portion. The spermatic vessels, it must be remembered, separate from the vas deferens soon after entering the abdominal cavity, whilst the latter is enwrapped in a loose fold of the peritoneum and continues its course alone until it meets the ureter from an inch to two inches above the bladder, where they take a parallel course as already described.

Experiment No. 10 was made on a twenty-pound bull bitch pup in the same manner as heretofore described, excepting that this experiment was made in day time and with all the advantages a good light afforded, and instead of making half-inch incisions in the rectum, as heretofore, we made very small openings just large enough to admit the ureter without constricting it, and closed the opening into the bowel with a modified Lambert suture, the same as described in No. 9, under the head of "Unilateral Implantations." The right ureter was inserted very low down near the bladder, and the left about three inches higher up. We had considerable trouble with the Fallopian tubes; which is always the case in making this operation on the female dog, as the ureters pass over the Fallopian tubes when the dog is standing, and, consequently, when lying on its back in an operation, they are under, and we are obliged to cut through the peritoneal folds of the Fallopian tubes in order to bring the ureters through them into the rectum, which always produces more or less hemorrhage and increases the chances of peritonitis.

In the canine it must be remembered that the Fallopian tubes are very long, and frequently extend more than half way from the bladder to the stomach, and consequently are always in the way when making this operation. This dog rallied slowly, and died of acute peritonitis thirty-six hours after the operation.

You will observe by examining specimen No. 10 (see plate No. 10) that both ureters were implanted in the rectum and were held in place by the ligatures and plastic adhesions, the latter of which had already been developed. By examining the ends of the ureters, which protrude into the lumen of the bowel, it will be observed that one of the loops (already described) used in drawing the ligature into place still remains, but the loop has been cast off from the right ureter. There was no hydronephrosis, showing that no obstruction of the ureters had been produced.

Experiment No. 11 was made on a puny mongrel of about 15 pounds weight. The ordinary operation was made and the right ureter was implanted in the rectum about an inch above, and the left about two inches above the bladder. The dog rallied promptly and partook freely of milk and water, in which we gave him some tincture of opium. The second day, however, symptoms of acute nephritis set in, from which the dog died in 72 hours after the operation, which fact was confirmed by the post-mortem examination.

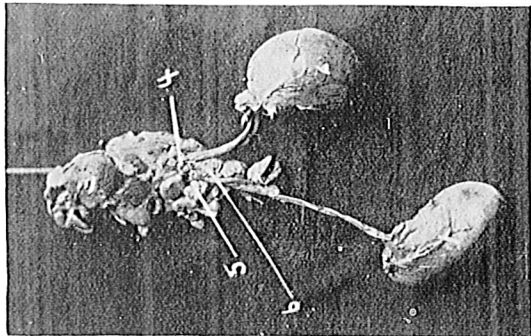
There was slight obstruction of the right ureter, producing hydronephrosis with intense inflammation of the right kidney. There was no obstruction of the left ureter, which was intensely congested, as was also the left kidney. By examining specimen No. 11 you will observe that both ureters were perfectly implanted in the rectum, and their serous surfaces were nicely welded to the peritoneal walls of the same by plastic lymph.

The right ureter was unfortunately torn from its nidus in the rectum by the rudeness of my assistant while making the post mortem. I have replaced it as near as possible as it was before the accident. There was but little peritoneal inflammation or rectal irritation; the dog had passed several liquid stools between the time of the operation and his demise. The sloughing process which was taking place is plainly shown by an examination of the rectal ends of each ureter.

Experiment No. 12 was made on a young shepherd dog of about 20 pounds weight. Both ureters were introduced in the usual manner and covered with a flap of omentum, which was stitched to the rectum with fine catgut sutures, thus supporting the ureters and at the same time protecting them as well as guarding against the possible escape of fecal matter from the rectum. He soon rallied from the operation, and ate and drank freely, being restricted to fresh beef, milk and water, given in moderate quantities every three or four hours. He was also kept under the influence of opiates until the night of the second day, when he got out of the barn and ran off, and did not return until the morning of the third day, when he returned very much fatigued and somewhat feverish. He refused all food, but would drink freely of water and occasionally would take a little milk.

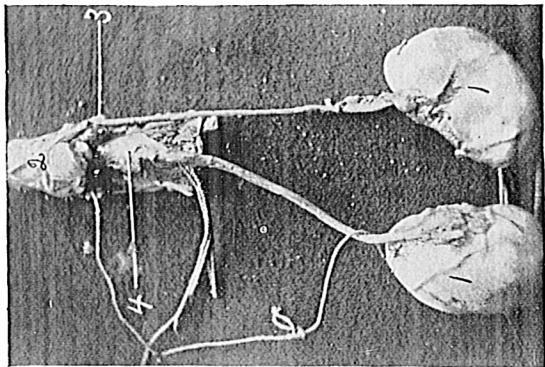
He did not have a motion of the bowels until the third day so far as we know, the stools being watery and having the distinct odor of urine.

Having found a large circumscribed ecchymosis in the abdominal walls during the operation, the result of an injury received prior to the operation, I suspected this might have some influence in producing his unfavorable condition, which continued to grow worse until



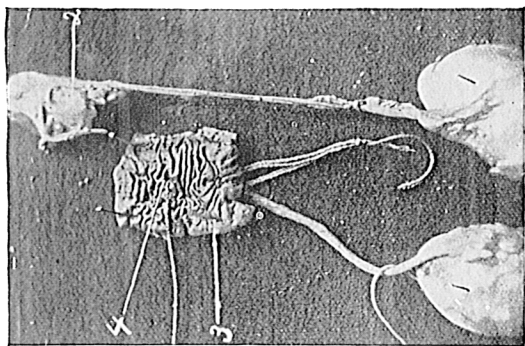
SPECIMEN No. 13.

Implantation of both ureters. Dog died 144 hours after operation of acute nephritis complicated with acute peritonitis.
1-1. Kidneys. 2. Rectum. 3. Bladder. 4. Right ureter. 5. Omental flap covering left ureter.



SPECIMEN No. 9a.

Unilateral implantation of the left ureter into the rectum. Dog killed on the 25th day after operation. (A.)
1-1. Kidneys. 2. Atrophied bladder. 3. Right ureter near entrance of bladder. 4. Left ureter implanted into rectum.



SPECIMEN No. 9b.

Unilateral implantation of the left ureter into the rectum. Dog killed on the 25th day after operation. (B.)
1-1. Kidneys. 2. Entrance of right ureter into atrophied bladder. 3. Mucous side of rectum. 4. Opening of ureter into rectum with cord passed through it.

he died, 90 hours after the operation. The post-mortem revealed the fact that an abscess had formed in the injured side, which had opened into the peritoneal cavity producing death. Both ureters were found inserted in the rectum, and well adhered, with no evidence of hydronephrosis.

The artificial openings into the mucous surfaces of the rectum were being rapidly repaired, and, notwithstanding the presence of the urine, the mucous membrane of the bowel did not show the slightest irritation. The bladder had taken on physiological atrophy, the result of non-use, until it had diminished to the size of a hickory nut. We are inclined to believe that the injury received prior to the operation ruined what otherwise promised to be a successful bilateral implantation. Unfortunately, however, an accident destroyed this specimen, which we are unable on that account to exhibit, very much to our regret.

Experiment No. 13 was made on a mongrel coach dog of about 30 pounds. Both ureters were implanted into the rectum in the manner already described; after which they were securely covered with flaps of omentum. This dog soon rallied and drank freely of milk and water. He passed urine per rectum the next morning after the operation, and continued to do so once or twice a day with marked regularity. He was given light doses of opiates, although he showed little evidence of pain until the fifth day after the operation, when symptoms of peritonitis set in, which rapidly increased until he died on the morning of the sixth day after the operation. The post-mortem revealed death to be the result of peritonitis and nephritis. By examining specimen No. 13 (see plate No. 13) you will observe that both ureters were firmly attached to the rectum and were held there in part by the omentum, which we removed from the one, but left remaining on the other. There was a slight degree of hydronephrosis showing some stenosis of the ureters, although not enough to have produced any serious damage to the kidney. (Judging from the amount of injury they will bear without serious results from ligation of the ureters, producing marked distension of the same, as well as of the kidney, from the accumulation of the urine.)

GENERAL REMARKS.

You will observe we have made in all twelve experimental operations, with reference to the implantation of the ureters into the rectum. Three were unilateral implantations, and nine were intended for bilateral implantations, of which only six proved to be double implantations of the ureters, whilst

two proved to be only the insertion of the folds of the peritoneum, and one proved to be the ingrafting into the rectum of both vasa deferentia. These experiments have been strung out over a period of over three years; and eight of them were conducted between the hours of ten and two o'clock at night, by the aid of a lamp, which, owing to the poor light, necessitated our depending largely upon the sense of touch for success.

I was kindly assisted by Drs. J. W. Craig, J. H. Craig, J. S. Hedges, Dr. Frank H. Harding, and occasionally others of the local profession, who kindly gave me all the assistance in their power in prosecuting these experiments, and to whom I am very much indebted for their aid, without which it would have been very difficult for me to have carried on these investigations.

In regard to the unilateral implantations, you will observe that numbers 4 and 9 were successful in every respect, whilst we have every reason to believe that No. 2 was successful also. By assuming that number 2 was not successful, we still have sixty-six per cent. of successful unilateral implantations.

In regard to the bilateral implantations, we are sorry to say we were not so fortunate; for all of the six bilateral implantations terminated fatally.

Of two experiments in which we implanted folds of the peritoneum instead of the ureters, one died (on the thirteenth day) of acute peritonitis, and the other one recovered. In the sixth experiment, however, in which we implanted both vasa deferentia in place of the ureters, the dog recovered with little or no difficulty.

CONCLUSIONS.

1. That the unilateral implantation of the ureter into the rectum is a possible and practical surgical procedure.
2. That the bilateral implantations of the vasa deferentia into the rectum is not followed by any serious or detrimental results, further than rendering the dog sterile.
3. That the simultaneous implantation of both ureters into the rectum is still a questionable surgical procedure, as shown by the experiments made thus far on the dog and also by Küster's double implantation of the ureters in man.
4. That the presence of the urine with the feces in the rectum does not produce pathological irritation of the latter, but

that the rectum will readily accommodate itself to its presence.

5. That the passing of frequent liquid stools cannot be depended upon as resulting from implantation of the ureters into the rectum, and the presence of urine in that receptacle.

6. That these experiments have suggested the probability of a portion of the water of the urine, being absorbed by the rectum, leaving the salts, etc., of the same to be eliminated from the economy with the feces.

7. That the ligation of one ureter, and the consequent production of hydronephrosis, is not necessarily followed by inflammation and destruction of the wall of the ureter or the substance of the kidney, and suggests one of two things: either the arrest of the secreting powers of the kidneys, or the reversal of the natural physiological process of elimination, for those of absorption.

PRACTICAL OBSERVATIONS.

We firmly believe that these experiments have shown, without much doubt, the practical utility of *unilateral* implantation of the ureter, in cases where either one of the ureters are involved, from the result of adhesions, from ovarian, or other tumors of the abdominal cavity; and that it is a safer procedure to resort to the implantation of the ureter into the rectum, than to perform a nephrectomy, which has been the custom heretofore. We also believe (and intend at some future time to endeavor to demonstrate by a continuation of these experiments), that bilateral implantations can be made successful by the introduction of one ureter at a time; giving the first one time to recover before the second one is implanted. If this can be accomplished, it will enable us, in cases of disease of the bladder, to divert the urine from that organ to the rectum, and thus either relieve the disease, or, if necessary, extirpate the bladder (which at present cannot be done), without bringing the ureter out through the perineum with all the horrors of such an unpleasant condition, which is only excelled by an artificial anus.

If, however, we have only succeeded in preventing the necessity of a nephrectomy by these experiments, where one or the other ureter is involved by some pathological difficulty in the abdominal cavity, necessitating the same, we will feel justified in the expenditure of the time and trouble these experiments have necessitated.